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Resarch Article

Predictive Role of Age and Albumin Levels on All-Cause Mortality in Early Hemodialysis Patients

Min-Jia Li*, Sheng-Rong Li, Jian-Hong Zhang

Blood purification center, The Third Affiliated Hospital, Sun Yat-Sen University, Yuedong Hospital, Meizhou city, Guangdong province 514700, China

***Corresponding author:** Min-jia Li, Blood purification center, The Third Affiliated Hospital, Sun Yat-Sen University, Yuedong Hospital, Meizhou city, Guangdong province 514700, China

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Abstract

Background: TThis study aimed to investigate the predictive role of baseline data on all-cause mortality in patients during the early stages of dialysis (3-6 months).

Methods: A retrospective cohort study was conducted, collecting baseline data from dialysis patients, including age, gender, urea nitrogen, albumin, potassium, hemoglobin, iron, ferritin, transferrin saturation, parathyroid hormone, calcium, phosphorus, carbon dioxide combining power, uric acid, creatinine, glucose, cholesterol, low-density lipoprotein, and C-reactive protein. The study included 377 patients, with 105 in the deceased group. Univariate and multivariate Cox regression analyses were used to evaluate the predictive role of these factors on all-cause mortality.

Results: Multivariate Cox regression analysis identified age ($P < 0.001$) and albumin ($P = 0.010$) as significant independent predictors of all-cause mortality. Each additional year of age increased the risk of mortality by 5.2%, while each 1 g/L increase in albumin decreased the risk of mortality by 7.5%.

Conclusion: Age and albumin levels are important predictors of all-cause mortality in patients during the early stages of dialysis. Patients with slower recovery of albumin levels during this period may face a higher risk of mortality. These findings underscore the importance of monitoring and improving nutritional status in clinical practice to enhance the prognosis of dialysis patients.

Keywords: All-Cause Mortality; Age; Albumin; End-Stage Renal Disease (ESRD); Hemodialysis

Introduction

Hemodialysis is a widely used renal replacement therapy for patients with End-Stage Renal Disease (ESRD), aimed at removing metabolic waste and excess fluids from the body. However, the mortality rate among hemodialysis patients remains high, especially during the early stages of treatment. Identifying key factors that can predict the prognosis of these patients is crucial for improving treatment outcomes and increasing survival rates. This study aims to investigate the predictive role of baseline data on all-cause mortality in patients during the early stages of dialysis (3-6 months), with a specific focus on the impact of age and albumin levels on mortality risk. Age and nutritional status are well-documented factors influencing the prognosis of hemodialysis patients. Numerous studies have shown that age is a significant predictor of mortality in dialysis patients. Elderly patients, due to multiple comorbidities and declining physiological functions, have a significantly higher risk of mortality. For example, Ahbap et al. found that younger age was associated with a higher five-year survival rate in maintenance hemodialysis patients [1]. Additionally, Qureshi et al. noted that age is an independent predictor of prognosis in dialysis patients, with each additional year of age increasing the risk of mortality [2].

Albumin, an important marker of nutritional status, has also been extensively studied. Low albumin levels are associated with a higher risk of mortality. Weng et al. found that low albumin levels are significant predictors of mortality in dialysis patients [3]. Victoroff et al. further indicated that low albumin levels combined with high

C-Reactive Protein (CRP) levels predict high mortality in dialysis patients [4] . Other biochemical indicators such as hemoglobin, serum iron, and ferritin also play important roles in the prognosis of dialysis patients. Kato et al. demonstrated that hemoglobin levels are closely related to long-term survival in patients [5] . Similarly, Hsiao et al. found that ferritin levels are crucial factors affecting the prognosis of dialysis patients, with high ferritin levels being associated with higher mortality [6]. These studies underscore the importance of age and albumin levels in predicting the prognosis of dialysis patients. However, there is relatively little research on the impact of these indicators on all-cause mortality during the early stages of dialysis (3-6 months). Therefore, this study aims to fill this gap by systematically evaluating the predictive role of age and albumin levels on all-cause mortality during the early stages of dialysis, providing better guidance for clinical practice.

Methodology

Study Design and Population

This retrospective cohort study was conducted at the Blood Purification Center, The Third Affiliated Hospital of Sun Yat-sen University, Yuedong Hospital. A total of 377 patients who initiated hemodialysis between September 1, 2015, and December 31, 2022, were included. Among these, 105 patients were classified into the deceased group, while the remaining 272 were in the surviving group.

Inclusion and Exclusion Criteria

Inclusion Criteria

1.Patients aged 18 years or older.

2.Patients who started hemodialysis between September 1, 2015, and December 31, 2022.

3.Patients who underwent hemodialysis for at least 3 months.

4.Availability of complete baseline data and follow-up information.

Exclusion Criteria

1.Patients with acute kidney injury requiring temporary dialysis.

2.Patients who received kidney transplantation before or during the study period.

3.Patients with incomplete baseline data or missing follow-up information.

Data Collection

Baseline data were collected at the beginning of dialysis and included age, gender, dialysis vintage (months), serum urea nitrogen, serum albumin, serum potassium, hemoglobin, serum iron, serum ferritin, serum transferrin saturation, parathyroid hormone, serum calcium, serum phosphorus, serum carbon dioxide combining power, serum uric acid, serum creatinine, serum glucose, serum cholesterol, serum low-density lipoprotein, and serum C-reactive protein. Blood samples were taken before dialysis sessions at 3 to 6 months after the initiation of hemodialysis to ensure the stability of the measured parameters. Follow-up continued until December 31, 2022.

Statistical Analysis

Baseline Data Analysis: Baseline characteristics of the deceased and surviving groups were summarized and compared. Continuous variables were expressed as mean ± Standard Deviation (SD) and compared using the independent samples t-test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test.

Univariate Cox Regression Analysis: Each baseline variable was subjected to univariate Cox regression analysis to evaluate its association with all-cause mortality. Variables with a P-value < 0.1 were considered significant and included in the multivariate analysis.

Multivariate Cox Regression Analysis: Variables identified as significant in the univariate analysis were included in the multivariate Cox regression analysis to identify independent predictors of all-cause mortality. The results were expressed as Hazard Ratios (HR) with 95% Confidence Intervals (CI). A P-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Third Affiliated Hospital of Sun Yat-sen University, Yuedong Hospital. Informed consent was obtained from all participants or their legal guardians before data collection.

Results

Baseline Characteristics

In this study, we included 377 hemodialysis patients, categorized into deceased (n=105) and surviving (n=272) groups. Baseline characteristics such as age, gender, dialysis vintage, and various serum markers were compared between the two groups to identify significant differences.

Comparison between Deceased and Surviving Groups

Table 1 summarizes the baseline data comparison between deceased and surviving groups. Notably, the deceased group had a significantly higher median age (71 years) compared to the surviving group (61 years), with a p-value of 0.000. Gender distribution was similar across both groups, with males comprising 66.7% of the deceased group and 63.2% of the surviving group (p=0.309).

While the median dialysis vintage did not differ significantly between the groups (p=0.155), there were notable differences in several serum markers. The serum albumin levels were significantly lower in the deceased group (35.65±4.28 g/L) compared to the surviving group (36.83±3.96 g/L) with a p-value of 0.012. Other significant differences included higher serum ferritin levels and higher serum glucose levels in the deceased group.

Variable	Deceased Group (n=105)	Surviving Group (n=272)	Overall (n=377)	P-value
Age (years)	71(62,77)	61(53,69)	64(55,72)	0
Gender (male)	70(66.7%)	172(63.2%)	242(64.2%)	0.309
Dialysis vintage (months)	38(22,60)	34(16.58)	35(18,35)	0.155
Serum Urea nitrogen (mmol/L)	23.8,(19.57,28.56)	24.77(20.69,30.05)	24.3(20.28,29.51)	0.141
Serum Albumin (g/L)	35.65±4.28	36.83±3.96	36.5±4.08	0.012
Serum Potassium (mmol/L)	4.76(4.3,5.5)	4.8(4.3,5.33)	4.8(4.30,5.38)	0.806
Hemoglobin (g/L)	90.64±22.25	94.72±21.11	93.58±21.48	0.098
Serum Iron (mmol/L)	8.9(7.1,10.6)	9(7,12.9)	9(7.08,12.60)	0.535
Serum Ferritin (μg/L)	105(50.6,225.5)	125.5(52.13,252.8)	118.3(51.95,236.3)	0
Serum Transferrin saturation (%)	20.94(15.53,28.64)	22(14.36,30.03)	21.78(15.0,29.64)	0.757
Serum Parathyroid hormone (pg/mL)	308.49(157.5,459.4)	301.9(178,519.8)	303.3(175.03,499.75)	0.552
Serum Calcium (mmol/L)	2.14±0.29	2.17±0.26	2.16±0.27	0.443
Serum Phosphorus (mmol/L)	1.75(1.47,2.12)	1.83(1.45,2.26)	1.79(1.46,2.23)	0.668
Serum Carbon dioxide combining power (mmol/L)	(17.50(14.9,20.3)	18.4(16.2,20.7)	1.79(1.46,2.23)	0.033
Serum Uric acid (μmol/L)	474(421,538)	492.8(422,556)	488.3(421.75,550.25)	0.654
Serum Creatinine (μmol/L)	829.1(667.3,1045.5)	886.4(705.6,1410.8)	869.85(694.5,1117.03)	0.098
Serum Glucose (mmol/L)	8.76(6.85,10.98)	7.73(6.16,10.37)	7.88(6.27,10.68)	0.017
Serum Cholesterol (mmol/L)	3.82(3.25,4.89)	4.13(3.4,4.88)	4.07(3.37,4.88)	0.384
Serum Low-density lipoprotein (mmol/L)	1.94(1.53,2.55)	2.04(1.51,2.5)	2.03(1.52,2.53)	0.637
Serum C-reactive protein (mg/L)	5(1.7,9.4)	4.7(2.3,9.6)	4.8(2.7,9.53)	0.262

Table 1: Baseline Data Comparison.

Univariate Cox Regression Analysis

The univariate Cox regression analysis identified several significant predictors of all-cause mortality ($P < 0.1$), including age ($P < 0.001$), serum urea nitrogen ($P = 0.029$), serum albumin ($P < 0.001$), serum potassium ($P = 0.071$), serum iron ($P = 0.061$), serum ferritin ($P = 0.007$), serum transferrin saturation ($P = 0.099$), parathyroid hormone ($P = 0.003$), serum phosphorus ($P = 0.005$), serum creatinine ($P < 0.001$), and serum glucose ($P = 0.003$) (Table 2).

Variable	B	SE	Wald	df	Sig.	Exp(B)	95.0% CI for Exp(B)	
							Lower	Upper
Age (years)	0.059	0.009	39.079	1	0	1.061	1.041	1.08
Gender (male)	-0.114	0.208	0.299	1	0.585	0.893	0.594	1.342
Serum Urea nitrogen (mmol/L)	-0.029	0.013	4.766	1	0.029	0.971	0.946	0.997
Serum Albumin (g/L)	-0.108	0.025	18.454	1	0	0.898	0.855	0.943

Serum Potassium (mmol/L)	-0.216	0.12	3.256	1	0.071	0.806	0.637	1.019
Hemoglobin (g/L)	-0.006	0.005	1.745	1	0.186	0.994	0.985	1.003
Serum Iron (mmol/L)	-0.039	0.021	3.518	1	0.061	0.962	0.923	1.002
Serum Ferritin (μg/L)	-0.001	0	7.236	1	0.007	0.999	0.998	1
Serum Transferrin saturation (%)	-0.012	0.007	2.729	1	0.099	0.988	0.975	1.002
Parathyroid hormone (pg/mL)	-0.001	0	9.004	1	0.003	0.999	0.998	1
Serum Calcium (mmol/L)	-0.518	0.336	2.378	1	0.123	0.595	0.308	1.151
Serum Phosphorus (mmol/L)	-0.406	0.143	8.061	1	0.005	0.666	0.503	0.882
Serum Carbon dioxide combining power (mmol/L)	0	0.008	0.003	1	0.955	1	0.985	1.015
Serum Uric acid (μmol/L)	-0.001	0.001	1.487	1	0.223	0.999	0.998	1.001
Serum Creatinine (μmol/L)	-0.001	0	20.474	1	0	0.999	0.998	0.999
Serum Glucose (mmol/L)	0.065	0.022	9.073	1	0.003	1.068	1.023	1.114
Serum Cholesterol (mmol/L)	-0.06	0.092	0.431	1	0.511	0.942	0.787	1.127
Serum Low-density lipoprotein (mmol/L)	-0.08	0.136	0.348	1	0.555	0.923	0.708	1.204
Serum C-reactive protein (mg/L)	0.006	0.007	0.656	1	0.418	1.006	0.992	1.02

Table 2: Univariate Cox Regression Analysis Results.

Multivariate Cox Regression Analysis

Multivariate Cox regression analysis included significant variables from the univariate analysis. Age (HR = 1.052, 95% CI: 1.032-1.073, P < 0.001) and serum albumin (HR = 0.925, 95% CI: 0.871-0.981, P = 0.010) remained significant independent predictors of all-cause mortality. Specifically, each additional year of age increased the risk of mortality by 5.2%, while each 1 g/L increase in serum albumin decreased the risk of mortality by 7.5% (Table 3).

Variable	B	SE	Wald	df	Sig.	Exp(B)	95.0% CI for Exp(B)	
							Lower	Upper
Age (years)	0.051	0.01	25.74	1	0	1.052	1.032	1.073
Serum Urea nitrogen (mmol/L)	0.016	0.018	0.814	1	0.367	1.016	0.982	1.052
Serum Albumin (g/L)	-0.078	0.03	6.701	1	0.01	0.925	0.871	0.981
Serum Potassium (mmol/L)	0.012	0.129	0.009	1	0.926	1.012	0.786	1.304
Serum Iron (mmol/L)	0.013	0.055	0.055	1	0.814	1.013	0.91	1.128
Serum Ferritin (μg/L)	-0.001	0.001	2.984	1	0.084	0.999	0.998	1
Serum Transferrin saturation (%)	-0.002	0.019	0.009	1	0.926	0.998	0.962	1.036
Parathyroid hormone (pg/mL)	-0.001	0	3.258	1	0.071	0.999	0.999	1
Serum Phosphorus (mmol/L)	0.035	0.187	0.036	1	0.85	1.036	0.718	1.496
Serum Creatinine (μmol/L)	-0.001	0	1.704	1	0.192	0.999	0.999	1
Serum Glucose (mmol/L)	0.018	0.024	0.531	1	0.466	1.018	0.971	1.067

Table 3: Multivariate Cox Regression Analysis Results.

Discussion

Our retrospective analysis of baseline data from 377 hemodialysis patients identified age and albumin levels as significant predictors of all-cause mortality. Multivariate Cox regression analysis confirmed that age and albumin levels are independent predictors. Each additional year of age increased the risk of mortality by 5.2%, while each 1 g/L increase in serum albumin decreased the risk by 7.5%. Age is a well-established factor influencing the prognosis of dialysis patients. Numerous studies have demonstrated that elderly patients have a significantly higher risk of mortality due to comorbidities and declining physiological functions. For instance, Tang et al. found that older age is associated with higher mortality in hemodialysis patients [7]. Similarly, Ma and Zhao confirmed that age is an independent predictor of prognosis in dialysis patients, with each additional year of age increasing the risk of mortality [8]. Our study reaffirms these findings, highlighting the importance of age as a robust predictor of mortality in the early stages of hemodialysis. Nutritional status, as indicated by albumin levels, is crucial for patient outcomes. Low albumin levels often reflect poor nutrition and high inflammation, both associated with adverse outcomes.

Minatoguchi et al. found that low serum albumin levels are significant predictors of infection-related in-hospital death among hemodialysis patients [9]. Additionally, Caetano et al. showed that low albumin levels combined with high inflammation markers predict high mortality in dialysis patients [10]. Our findings support that maintaining adequate nutritional status is vital for improving survival rates among hemodialysis patients. Other biochemical indicators, such as hemoglobin, serum iron, and ferritin, also affect the prognosis of dialysis patients. Although these factors were significant in univariate analyses, they did not retain their predictive power in multivariate analysis. This suggests that their effects might be mediated through age and albumin levels. For example, Shayan et al. demonstrated that serum hemoglobin levels between 11 and 12.5 g/dL decrease the risk of death in long-term hemodialysis patients [11]. Hwang et al. found that high ferritin levels are associated with higher mortality [12]. Our results align with previous research on the importance of age and albumin in predicting mortality among hemodialysis patients. However, our study specifically focuses on the early stages of dialysis (3-6 months), a less studied period, providing a detailed understanding of how these factors influence outcomes shortly after dialysis initiation. In conclusion, our study demonstrates that age and albumin levels are significant independent predictors of all-cause mortality in hemodialysis patients during the early stages of treatment. These findings underscore the importance of regular monitoring and management of these factors to improve patient outcomes. Future research should explore additional variables and multicenter data to enhance the generalizability of these results and provide more comprehensive guidance for clinical practice.

Limitations of the Study

This study has several limitations. First, as a retrospective cohort study, it is subject to selection bias. Second, the study was conducted at a single center, which may limit the generalizability of our findings. Third, we did not account for other potentially influential factors such as patients' quality of life, psychological state, and socioeconomic status. Future research should consider these aspects to provide a more comprehensive evaluation of prognostic factors in hemodialysis patients.

References

1. Ahbap E, Hasbal NB, Sevinc M (2022) Factors Associated with Long-Term Survival in Maintenance Hemodialysis Patients: A 5-Year Prospective Follow-Up Study. The Medical Bulletin of Sisli Etfal Hospital 56: 414-420.
2. Qureshi AR, Alvestrand A, Divino-Filho J, Gutierrez A, Heimbürger O, et al. (2002) Inflammation, malnutrition, and cardiac disease as predictors of mortality in hemodialysis patients. Journal of the American Society of Nephrology 13: S28-36.
3. Weng C, Hu, C-C, Yen T-H, Hsu C-W, Huang W-H (2016) Nutritional Predictors of Mortality in Long Term Hemodialysis Patients. Scientific Reports 6: 35639.
4. Victoroff A, Molnar M, Jing J, Streja E, Ravel VA, et al. (2012) Association of serum albumin and mortality in elderly dialysis patients. Kidney Research and Clinical Practice 31: A41.
5. Kato A, Takita T, Furuhashi M, Maruyama Y, Hishida A (2010) Comparison of serum albumin, C□reactive protein and carotid atherosclerosis as predictors of 10□year mortality in hemodialysis patients. Hemodialysis International 14: 226-232.
6. Hsiao K-C, Tsai J-C, Yang S-F, Lee W-C, Huang J-Y, et al. (2016) MMP-2 serum concentrations predict mortality in hemodialysis patients: a 5-year cohort study. Clinica Chimica Acta; International Journal of Clinical Chemistry 452: 161-166.
7. Tang J, Wang L, Luo J, Xi D, Huang W, et al. (2021) Early albumin level and mortality in hemodialysis patients: a retrospective study. Annals of palliative medicine 10: 10697-10705.
8. Ma L, Zhao S (2017) Risk factors for mortality in patients undergoing hemodialysis: A systematic review and meta-analysis. International journal of cardiology 238: 151-158.
9. Minatoguchi S, Nomura A, Imaizumi T (2018) Low serum albumin as a risk factor for infection-related in-hospital death among hemodialysis patients hospitalized on suspicion of infectious disease: a Japanese multicenter retrospective cohort study. Renal Replacement Therapy 4: 1-7.
10. Caetano C, Valente A, Oliveira T, Garagarza C (2016) Body Composition and Mortality Predictors in Hemodialysis Patients. Journal of renal nutrition 26: 81-86.
11. Shayan Z, Ebrahimi V, Jahromi SE (2020) Factors Associated With Short-Term and Long-Term Survival in Patients Undergoing Hemodialysis Using Semi-Parametric Mixture Cure Models. Iranian Journal of Kidney Diseases 14: 44.
12. Hwang J, Jiang M, Lu Y-H, Wang C-T (2015) Precedent Fluctuation of Serum hs-CRP to Albumin Ratios and Mortality Risk of Clinically Stable Hemodialysis Patients. PLoS ONE 10: e0120266.